(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 September 2005 (22.09.2005)

PCT

(10) International Publication Number
WO 2005/086966 A2

(51) International Patent Classification: Not classified

(21) International Application Number:
PCT/US2005/008258

(22) International Filing Date: 11 March 2005 (11.03.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/552,378 11 March 2004 (11.03.2004) US

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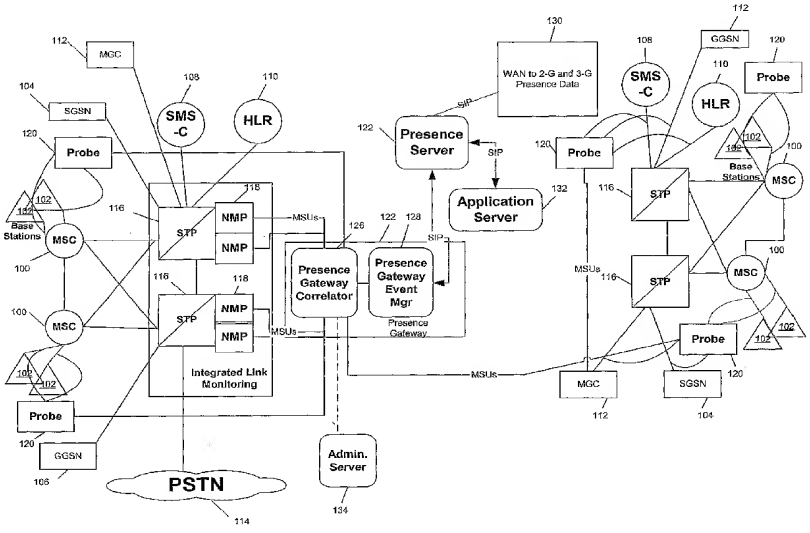
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,

*[Continued on next page]*

(54) Title: METHODS, SYSTEMS, AND COMPUTER PROGRAM PRODUCTS FOR PROVIDING PRESENCE GATEWAY FUNCTIONALITY IN A TELECOMMUNICATIONS NETWORK




(57) Abstract: A method for providing presence gateway functionality includes deriving presence information for subscribers in a first set of subscribers based on telecommunications signaling messages. The first set of subscribers includes at least one subscriber who is not a subscribed-to presentity. The method also includes determining whether presence status information for a subscriber in the first set of subscribers has changed. In response to detecting a change in presence status, it is determined whether the subscriber is a subscribed-to presentity. If the subscriber is a subscribed-to presentity, a presence server is notified of the change in status of the subscriber.

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ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

— *without international search report and to be republished upon receipt of that report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# DESCRIPTION

# METHODS, SYSTEMS, AND COMPUTER PROGRAM PRODUCTS FOR PROVIDING PRESENCE GATEWAY FUNCTIONALITY IN A TELECOMMUNICATIONS NETWORK

## RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application Serial No. 60/552,378, filed March 11, 2004; the disclosure of which is incorporated herein by reference in its entirety.

## TECHNICAL FIELD

The subject matter described herein relates to methods, systems, and computer program products for maintaining and delivering presence information. More particularly, the subject matter described herein relates to methods, systems, and computer program products for providing presence gateway functionality for maintaining and delivering presence information in a telecommunications network.

## BACKGROUND ART

Presence information refers to contact information concerning a entity, referred to as a presentity, to which other entities can subscribe in a presence server database. For example, if a presentity is a mobile telecommunications subscriber, presence information that is stored for the subscriber may include the current location of the subscriber and whether or not the subscriber's handset is on or off. Another entity or application may subscribe to the presentity by sending a subscribe message to a presence server. The presence server may notify the subscribing entity of the initial presence status of the presentity and of changes in presence status of the presentity.

In some conventional networks that use presence protocols, a subscriber is required to have a general packet radio service (GPRS) handset with a presence client running on the handset in order for the presence information for the subscriber to be updated in the presence server database. For example, when a subscriber with a GPRS handset activates his or her handset in a new location area, the presence client on the subscriber's handset may

automatically send a message to the presence database indicating that the subscriber is located in a particular area and that the subscriber's handset is activated.

Requiring that each subscriber have a presence client running on his or her handset in order for presence information to be collected prevents the development of universal-applicable applications that rely on presence information. For example, not all subscribers have GPRS handsets, not to mention GPRS handsets with presence clients. Accordingly, applications, such as SMS, push-to-talk, instant messaging, and conference calling, that rely on presence information are limited to subscribers with specialized communications equipment. Stated differently, because presence information is not available regarding all types of subscribers, including subscribers without GPRS handsets, the applicability of applications that rely on presence information is limited.

Another problem with current presence implementations is that presence information is only maintained for subscribers who are currently subscribed to by other entities. If a subscriber is not currently subscribed to, presence information may not be stored in a presence server database for that subscriber. As a result, when a subscriber becomes subscribed to, there may be delay between the time that presence information is obtained and delivered to the subscribing entity.

Accordingly, in light of these difficulties associated with conventional presence implementations, there exists a need for improved methods, systems, and computer program products for providing presence gateway functionality in a telecommunications network.

## SUMMARY

According to one aspect of the subject matter described herein, a method for maintaining and delivering presence information regarding telecommunications network subscribers includes deriving presence information for a first set of telecommunications network subscribers based on telecommunications signaling messages relating to communications to or from members of the first set of subscribers. The first set of subscribers may include a set of potential presentities that represents subscribers who may or may not

be subscribed to by other entities. Based on the telecommunications signaling messages, it is determined whether the presence status associated with a subscriber in the first set has changed. In response to determining that the presence status has changed, it is determined whether the subscriber is a subscribed-to presentity. If the subscriber is determined to be a subscribed-to presentity, the presence server is notified of the change in presence status of the subscriber.

Because the subject matter described herein derives and maintains presence information for a first set of subscribers that includes subscribed-to presentities and non-subscribed-to presentities, when a subscriber in the set becomes a subscribed-to presentity, the time for distributing the presence information to the presence server and to the subscribers or applications seeking information regarding the presentity is reduced. As a result, the subject matter described herein reduces the time required for collecting and delivering presence information over conventional presence implementations.

The subject matter described herein for deriving and maintaining presence information may be implemented using hardware, software, firmware, or any combination thereof. In one exemplary implementation, the subject matter described herein may be implemented using a computer program product comprising computer executable instructions embodied in a computer readable medium. Exemplary computer readable media suitable for implementing the subject matter described herein includes chip memory devices, disk storage devices, application specific integrated circuits, and programmable logic devices.

## BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the subject matter described herein will now be explained with reference to the accompanying drawings of which:

Figure 1 is a network diagram illustrating an exemplary architecture for collecting signaling messages, deriving presence information regarding subscribed-to presentities and non-subscribed-to presentities based on the signaling messages, and delivering presence information to a presence server according to an embodiment of the subject matter described herein;

Figure 2 is a flow chart illustrating exemplary steps for filtering signaling messages to be delivered to a presence gateway correllator according to an embodiment of the subject matter described herein;

Figure 3 is a block diagram illustrating a distributed architecture for a presence gateway according to an embodiment of the subject matter described herein;

Figure 4 is a block diagram illustrating exemplary functional components of a presence gateway according to an embodiment of the subject matter described herein;

Figure 5 is a flow chart illustrating exemplary steps for deriving presence information for potential presentities based on ISUP messages according to an embodiment of the subject matter described herein;

Figure 6 is a flow chart illustrating exemplary steps for deriving presence information based on SIP messages according to an embodiment of the subject matter described herein;

Figure 7 is a flow chart illustrating exemplary steps for deriving presence information concerning potential presentities based on IS-41 messages according to an embodiment of the subject matter described herein;

Figure 8 is a flow chart illustrating exemplary steps for deriving presence information concerning potential presentities based on GSM messages according to an embodiment of the subject matter described herein;

Figure 9 is a flow chart illustrating exemplary steps for managing presence subscription information at a presence gateway according to an embodiment of the subject matter described herein;

Figure 10 is a flow chart illustrating exemplary steps that may be performed in managing events at a presence gateway according to an embodiment of the subject matter described herein;

Figure 11 is a message flow diagram illustrating exemplary messages for transferring subscription information from a presence server to a presence gateway according to an embodiment of the subject matter described herein; and

Figure 12 is a message flow diagram illustrating exemplary messages for delivering presence state information from a presence gateway to a presence server according to an embodiment of the subject matter described herein.

## DETAILED DESCRIPTION OF THE INVENTION

The subject matter described herein includes a presence gateway that manages potential presentity information, derives presence information from telecommunications signaling messages from a plurality of different nodes in the network, maintains presence information for both subscribed-to and non-subscribed-to presentities, and delivers presence information for subscribed-to presentities to a presence server. Figure 1 illustrates a telecommunications network including a presence gateway according to an embodiment of the subject matter described herein. Referring to Figure 1, the illustrated telecommunications network includes a plurality of nodes that exchange signaling messages in order to set up and tear down calls and send SMS messages. In the illustrated example, the telecommunications network includes mobile switching centers (MSCs) **100** and base stations **102** for enabling communication with wireless mobile subscribers. Similarly, serving GPRS support node (SGSN) **104** and gateway GPRS support node (GGSN) **106** enable communication with GPRS wireless mobile subscribers. A short message service center (SMS-C) **108** stores SMS messages and forwards the SMS messages to their intended destinations. A home location register (HLR) **110** stores mobile subscription and mobile subscriber location information.

A media gateway controller (MGC) **112** controls one or more media gateways (not shown in Figure 1) for calls over packet networks. MGC **112** also performs call setup signaling to establish and tear down voice over IP calls. PSTN **114** includes traditional wireline components to establish and tear down calls with wireline subscribers. For example, PSTN **114** may include one or more end office switches, databases, and other nodes that perform the signaling necessary to establish and tear down wireline calls.

Signal transfer points **116** route signaling messages between other nodes in the network. For example, signaling transfer points **116** may route SS7 signaling messages based on SS7 point codes. Signal transfer points **116** may also route IP telephony signaling messages based on IP addresses. Examples of IP telephony signaling messages that may be routed by STPs **116** include SIP messages, MGCP messages, and SS7 over IP messages.

The nodes on the right hand side of Figure 1 perform the same functions as the correspondingly numbered nodes on the left hand side of Figure 1. Accordingly, a description thereof will not be repeated herein. One difference between the nodes illustrated on the right hand side of Figure 1 and the nodes illustrated on the left hand side is that on the left hand side, STPs **116** include integrated link monitors **118**, whereas messages traversing STPs **116** on the right hand side are monitored through stand-alone link monitoring probes **120**. STPs **116** having integrated link monitors **118** may include message copy functions located on each interface card within the STP. The message copy functions forward copies of received messages to network monitoring processors **118**. Network monitoring processors **118** buffer message copies and forward the message copies to downstream applications. External network monitoring probes **120** include hardware and software that non-intrusively copy messages that traverse signaling links between various network nodes. One example of a commercially-available system suitable for implementing probes **118** and **120** is the Sentinel™ system available from Tekelec of Calabasas, California.

According to an aspect of the subject matter described herein, a presence gateway **122** receives signaling messages copied by probes **118** and **120**, generates presence information regarding non-subscribed-to presentities and subscribed-to presentities, and forwards presence information for subscribed-to presentities to a presence server **124**. In the illustrated example, presence gateway **122** includes a presence gateway correlator **126** for correlating messages relating to the same transaction or subscriber and a presence gateway event manager **128** for notifying presence server **124** of changes in presence status of a subscribed-to presentity.

Presence server **124** may receive presence status information from presence gateway **122** and from 2G and 3G networks **130**. Presence server **124** may also provide presence information to one or more application servers **132**. Application server **132** may implement one or more applications that use presence information. Examples of such applications may include SMS, push-to-talk, instance messaging, and conference calling.

An administration server **134** allows operators to provision a potential presentity database maintained by presence gateway **122**. Administration server **134** may also allow operators to control messages collected by probes **118** and **120**. For example, administration server **134** may allow an operator to define message filters used by probes **118** and **120** to identify messages of interest.

Figure 2 is a flow chart illustrating exemplary steps that may be performed by network monitoring probes **118** and **120** in screening signaling messages and forwarding the signaling messages to presence gateway correlator **126**. Referring to Figure 2, in step **200**, a message is received by a probe **118** or **120**. In step **202**, the probe determines the service or protocol type of the message. Determining the service or protocol type may include determining whether the message is an ISUP, IS-41, GSM, SIP, MGCP, GPRS or other type of message. In step **204**, it is determined whether the message is a message of interest. Determining whether the message is a message of interest may include comparing the determined message type to a list **206** of provisioned message types. List **206** may be provisioned by an operator via administration server **134** illustrated in Figure 1. If the message is determined to be a message of interest, control proceeds to step **208** where the message is forwarded to presence gateway correlator **126**. If the message is determined not to be a message of interest, processing ends for this message and control returns to step **200** where the next message received by the probe is processed.

Figure 3 is a block diagram illustrating a distributed implementation of presence gateway **122**. In Figure 3, presence gateway **122** includes a plurality of presence gateway correlators **126** connected to a single presence gateway event manager **128** via a LAN/WAN **300**. Each presence gateway correlator **126** receives messages of interest from probes **118** and **120**. Presence gateway event manager **128** receives events detected by each correlator and forwards the events relating to subscribed-to presentities to presence server **124**.

Figure 4 illustrates an exemplary architecture for presence gateway **122** in more detail. Referring to Figure 4, presence gateway correlator **126** includes

a database **400** of potential presentities. As described above, potential presentities may include subscribed-to presentities and non-subscribed-to presentities representing the universe of subscribers for which a service provider may desire to obtain presence information. Because correlator **126** stores presence information regarding potential presentities who are not subscribed-to presentities, the delivery of presence information regarding these subscribers can be expedited over conventional presence implementations where presence information is collected only for subscribed-to presentities. That is, because correlator **126** derives and caches presence information for non-subscribed-to presentities, presence information for these entities can be readily obtained when a subscription to one of the entities occurs.

In the illustrated example, presence gateway correlator **126** selects and correlates messages where the called or calling party is a potential presentity, detects events regarding potential presentities, and passes the events to event manager **128**. Event manager **128** includes a database **402** of subscribed-to presentities. Subscribed-to presentities may be subscribers whose presence status is currently being monitored by another subscriber or application. Entries in subscribed-to presentity database **402** may be dynamically updated based on SIP subscription messages and subscription cancellation messages from presence server **124**. If an entity is a subscribed-to presentity and an event occurs that results in a change in presence status for a subscribed-to presentity, event manager **128** may send a notification to presence server **124**.

Although in the example illustrated in Figure 4, separate databases are shown for storing information regarding potential presentities and subscribed-to presentities, the subject matter described herein is not limited to a two-database implementation. In an alternate implementation, databases **400** and **402** can be combined without departing from the scope of the subject matter described herein.

One type of message for which it may be desirable to derive presence information is ISDN user part (ISUP) messages. Figure 5 is a flow chart illustrating exemplary steps that may be performed by presence gateway correlator **126** in correlating ISUP messages according to an embodiment of the subject matter described herein. Referring to Figure 5, in step **500**, presence

gateway correlator **126** receives an ISUP message. In step **502**, it is determined whether the message is an initial address message (IAM). If the message is IAM message, control proceeds to step **504** where it is determined whether the IAM message concerns a potential presentity. This step may be performed by comparing the calling party in the IAM message to potential presentities stored in database **400**. If the IAM message does not concern a potential presentity, correlation processing for this message stops.

If the IAM message concerns a potential presentity, control proceeds to step **506** where a new call object is created. The call object may be a data structure stored by correlator **126** relating to a call from the potential presentity. Because an IAM message represents call initiation, control proceeds to step **508** where correlator **126** generates an off hook event. An off hook event may be used to notify presence server that a subscriber is currently on the phone and therefore currently unable to receive other voice communications. In step **510**, correlator **126** communicates the off hook event to event manager **128**.

Returning to step **502**, if the ISUP message is determined to be a message other than an IAM message, control proceeds to step **512** where it is determined whether the non-IAM message matches an existing IAM message. Determining whether a non-IAM message matches an existing IAM may include comparing the originating point code (OPC), destination point code (DPC), and circuit identifier code (CIC) to existing call objects. If the message does not match an existing IAM message, correlation processing stops for this message. If the message matches an existing IAM message, control proceeds to step **514** where it is determined whether the message is an answer message (ANM). If the message is an answer message, control proceeds to step **516** where an answer event is generated and step **510** where the event is transferred to event manager **128**.

In step **514**, if the message is determined not to be an answer message, control proceeds to step **518** where it is determined whether the message is a release (REL) or release complete (RLC) message. If the message is a release or release complete message, control proceeds to step **520** where a release event is generated. Control then returns to step **510** where the event is transferred to event manager **128**.

Figure 6 is a flow chart illustrating exemplary steps that may be performed by correlator **126** in correlating SIP messages relating to a call origination. Referring to Figure 6, in step **600**, correlator **126** receives a SIP message. In step **602**, correlator **126** determines whether the SIP message is an INVITE message. If the message is an INVITE message, control proceeds to step **604** where it is determined whether the INVITE message concerns a potential presentity. If the INVITE message concerns a potential presentity, control proceeds to step **606** where a new call object is created. In step **608**, an off-hook event is generated. In step **610**, the off-hook event is communicated to event manager **128**.

In step **602**, if the SIP message is determined not to be an INVITE message, control proceeds to step **612** where it is determined whether the message matches an existing INVITE message. If the message matches an existing INVITE message, control proceeds to step **614** where it is determined whether the message concerns a potential presentity. If the message concerns a potential presentity, control proceeds to step **616** where it is determined whether the message is a BYE message. If the message is a BYE message, control proceeds to step **618** where a release event is generated. Control then proceeds to step **610** where the release event is communicated to event manager **128**.

Returning to step **602**, if the INVITE message is determined not to concern a potential presentity, correlation processing may cease for this message. Similarly, in step **614**, if the non-INVITE SIP message is determined not to concern a potential presentity, control proceeds to step **620** where correlation processing ceases for the message.

Returning to step **616**, if the message is determined to not to be a BYE message, control proceeds to step **624** where the message is correlated with other messages that have been received and stored for the session. In step **626**, correlator **126** analyzes the received messages for the session for an indication of an answer event. Searching for an indication of an answer event may include looking for a sequence of a Ringing message from the called party SIP proxy to the calling party SIP proxy, a 200 OK message from the called party SIP proxy to the calling party SIP proxy, and an ACK message from the

calling party SIP proxy to the called party SIP proxy. If this sequence of messages occurs, an answer event may be indicated. If an answer event is indicated, control proceeds to step **628** where an answer event is generated and to step **610** where the answer event is communicated to event manager **128**. Returning to step **626**, if an answer event is not indicated, control proceeds to step **630** where correlation processing for the message stops. Similarly, if in step **612** it is determined that the SIP message does not match an existing invite, control proceeds to step **632** where correlation processing for the message ceases.

Another type of message for which it may be desirable to derive presence information includes IS-41 messages relating to registration, roaming, and de-activation of mobile handsets. Figure 7 is a flow chart illustrating exemplary steps that may be performed by presence gateway correlator **126** in correlating IS-41 messages and generating presence status information based on the IS-41 messages. Referring to Figure 7, in step **700**, correlator **126** receives an IS-41 message. In step **702**, it is determined whether the message is registration notification message. If the message is registration notification message, control proceeds to step **704** where it is determined whether the registration notification message concerns a potential presentity. Determining whether the registration notification message concerns a potential presentity may include comparing the mobile subscriber identifier in the registration notification message with mobile subscriber identification information stored in database **400**. If the registration notification message concerns a potential presentity, control proceeds to step **706** where a new transaction object is created. In step **708**, correlator **126** generates a registration event. In step **710**, correlator **126** communicates the registration event to event manager **128**.

Returning to step **702**, if the IS-41 message is determined not to be a registration notification message, control proceeds to step **712** where it is determined whether the IS-41 message is a location request message. If the message is determined to be a location request message, control proceeds to step **714** where it is determined whether the location request message concerns a potential presentity. If the location request message concerns a potential presentity, control proceeds to step **716** where a new transaction

object is created. In step **718**, correlator **126** generates a roaming event. Control then proceeds to step **710** where the roaming event is transferred to event manager **128**.

Returning to step **712**, if the message is determined not to be a location request message, control proceeds to step **720** where it is determined whether the message is a mobile station inactive message. If the message is determined to be a mobile station inactive message, control proceeds to step **722** where it is determined whether the mobile station inactive message concerns a potential presentity. If the message concerns a potential presentity, control proceeds to step **724** where a new transaction object is created. In step **726**, correlator **126** generates a mobile off event indicating that the handset for the potential presentity has been deactivated. Control then proceeds to step **710** where correlator **126** transfers the handset off event to event manager **128**.

In step **720**, if the message is determined not to be a mobile station inactive event, correlation processing for this message ends. Similarly, in step **722**, if the message is determined not to relate to a potential presentity, correlation processing for the message ends.

Yet another type of message for which it may be desirable to derive presence information includes GSM messages relating to registration and roaming. Figure 8 is a flow chart illustrating exemplary steps that may be performed by correlator **126** in generating events based on GSM messages according to an embodiment of the subject matter described herein. Referring to Figure 8, in step **800**, correlator **126** receives a GSM message. In step **802**, correlator **126** determines whether the GSM message is a location update message. If the GSM message is a location update message, control proceeds to step **804** where it is determined whether the message concerns a potential presentity. Determining whether the message concerns a potential presentity may include determining whether the IMSI or MSISDN number in the message corresponds to an IMSI or MSISDN number stored in potential presentities database **400**. If the location update message concerns a potential presentity, control proceeds to step **806** where a new transaction object is created. In step **808**, a registration event is generated. In step **810**, correlator **126** communicates the registration event to event manager **128**.

Returning to step **802**, if it is determined that the GSM message is not a location update message, control proceeds to step **812** where it is determined whether the message is a send routing information (SRI) message. If the message is determined to be an SRI message, control proceeds to step **814** where it is determined whether the SRI message concerns a potential presentity. Determining whether the SRI message concerns a potential presentity may include comparing the IMSI or MSISDN number from the SRI message to entries in database **400** to determine whether the IMSI or MSISDN matches any of the entries. If the SRI message is determined to concern a potential presentity, control proceeds to step **816** where a new transaction object is created. In step **818**, correlator **126** generates a roaming event. In step **810**, correlator **126** communicates the roaming event to event manager **128**.

Returning to step **804** or step **814**, if the location update or SRI message does not concern a potential presentity, control proceeds to step **820** where correlation processing for the message ceases. Similarly, in step **812**, if it is determined that the message is not an SRI message or a location update message, correlation processing for the message ends (step **822**).

Although the example illustrated in Figure 8 includes identifying registration and roaming events based on GSM registration and location management messages, the subject matter described herein is not limited to identifying only these types of events or using only these types of messages. For example, similar procedures may be used to analyze mobile application part (MAP) or short message point to point (SMPP) messages to determine whether a potential presentity is available to receive SMS messages and the current location of the subscriber where the SMS messages can be delivered. Similarly, IS-41 messages relating to SMS delivery may be used to determine whether an IS-41 potential presentity is available to receive SMS messages and the current location of the IS-41 potential presentity where the SMS messages can be delivered.

As stated above, event manager **128** receives subscriptions from presence server **124** and manages subscriptions in subscribed-to presentity database **402**. Figure 9 is a flow chart illustrating exemplary steps that may be

performed by event manager **128** in managing subscriptions according to an embodiment of the subject matter described herein. Referring to Figure 9, in step **900**, event manager **128** receives a subscribe message from presence server **124**. In step **902**, event manager **128** adds a subscription to subscribed-to presentity database **402**. In step **904**, event manager **128** maps the subscription to the presence server that generated the subscription.

In step **906**, event manager **128** determines whether presence status information exists for the subscribed-to presentity. Determining whether presence status exists may include accessing presentity status database **404**. If status information exists, control proceeds to step **908** where event manager **128** generates a status event. In step **910**, event manager **128** transfers the status event to presence server **124**. Returning to step **906**, if presence status information does not exist for a new subscription, control proceeds to step **912** where an error condition is generated. The error condition may notify the operator that status information is not available for the subscriber.

As described above, another function performed by event manager **128** is receiving events from correlator **126** and notifying presence server **124** of events that relate to subscribed-to presentities. Figure 10 is a flow chart illustrating exemplary steps performed by event manager **128** in generating presence information and transferring the presence information to presence server **124**. Referring to Figure 10, in step **1000**, an incoming status event is detected. In step **1002**, it is determined whether the status event concerns a potential presentity. The step of determining whether the event concerns a potential presentity allows event manager **128** to associate event status with potential presentities without requiring that correlator **126** communicate potential presentity information along with the event to event manager **128**. In an alternate implementation, correlator **126** may communicate potential presentity information to event manager **128** along with each event, and step **1002** in Figure 10 may be eliminated. If the event concerns a potential presentity, control proceeds to step **1004** where it is determined whether event status exists for the potential presentity. If event status exists, control proceeds to step **1006** where it is determined whether the status has changed. If the status has changed, control proceeds to step **1008** where it is determined

whether the status concerns a subscribed-to presentity. If the event concerns a subscribed-to presentity, control proceeds to step **1010** where a status event is generated. In step **1012**, the status event is transferred to present server **124**.

Returning to step **1002**, if the status event does not concern a potential presentity, presence processing for the status event stops. In step **1004**, if presence status does not exist for a potential presentity, control proceeds to step **1014** where presentity status is added to presentity status database **404**. Storing presence status for potential presentities including presentities who are not currently subscribed to decreases the time for obtaining presence information when a new subscription occurs over conventional presence implementations. In step **1006**, if it is determined that the status has not changed, presence event processing ceases.

In one exemplary implementation, subscription information is transferred from presence server **124** to presence gateway **122** using SIP messages. Figure 11 is a flow chart illustrating exemplary SIP messages that may be exchanged between presence server **124** and presence gateway **122** in creating a new subscription. Referring to Figure 11, in line 1 of the message flow diagram, when an entity subscribes to a potential presentity, presence server **124** sends a subscribe message to presence gateway **122**. In response to the subscribe message, presence gateway **122** authenticates the presence server. If the presence server passes the authentication, in line 2 of the message flow diagram, presence gateway **122** sends a SIP 200 OK message to presence server **124**.

In line 3 of the message flow diagram, presence gateway **122** sends a Notify message indicating the current state of the subscribed-to presentity. In line 4 of the message flow diagram, presence server **124** sends a 200 OK message to presence gateway **122** confirming receipt of the Notify message.

As stated above, because presence gateway **122** maintains presence information regarding potential presentities who are not currently subscribed-to presentities, the time for obtaining status information when a potential presentity becomes a subscribed-to presentity is decreased over presence implementations where presence status information is only maintained for subscribed-to presentities. Using the message flow illustrated in Figure 11 as

an example, once presence gateway **122** receives a new subscription in line 1, presence gateway **122** can send the Notify message in line 3 indicating the current state of the subscribed-to presentity without requiring that the presence information be obtained from the subscriber's handset.

Another feature of the subject matter described herein is the communication between presence gateway **122** and presence server **124** when a change in status regarding a subscribed-to presentity occurs. In a preferred implementation, this communication also occurs using the SIP protocol. Figure 12 is a message flow diagram illustrating exemplary messages that may be exchanged between presence gateway **122** and presence server **124** in updating presence server **124** of changes in presence status. Referring to Figure 12, in line 1 of the message flow diagram, when presence gateway **122** detects a change in status of a subscribed-to presentity, presence gateway **122** sends a Notify message to presence server **124**. The Notify message includes a state change indicator indicating a new state of the subscribed-to presentity. For example, the state change may be communicated using an off hook event indicator for a subscribed-to presentity who was previously on hook. In line 2 of the message flow diagram, presence server **124** confirms receipt of the Notify message via a 200 OK message.

Although the examples described above relate primarily to deriving presence event information based on analyzing signaling messages of each protocol in isolation, the subject matter described herein is not limited to analyzing signaling messages of each protocol in isolation. For example, in one exemplary implementation, presence gateway **122** may analyze signaling messages relating to GSM and GPRS procedures together to determine whether a registration event has occurred. Such a method may include determining whether a GSM location update or a GPRS location update has occurred using steps similar to these described above with respect to Figure 8. If a GPRS location update and a GPRS location update have occurred, the presence information for the subscriber may be updated to include both GPRS and GSM registration and location information. One advantage to using both GSM and GPRS procedures is that location area units for GSM are different

than those of GPRS. By monitoring both GSM and GPRS messages, more up-to-date and accurate presence information can be achieved.

Another aspect of the subject matter described herein includes monitoring messages that are destined to multiple network elements, such as MSC/VLRs, HLRs, SMSCs, GMSCs, SGSNs, and GGSNs. In the architecture illustrated in Figure 1, probes **118** and **120** are connected to signal links and to signaling nodes that are capable of collecting messages from all of these network elements. By monitoring messages to multiple network elements, a network view of presence can be obtained as opposed to a single network element view, such as an HLR view.

Another advantage or feature of the subject matter described herein is that presence information is derived from messages relating to multiple services, such as call setup, call tear down, roaming, and location updating. Other services that may be monitored include SMS message delivery and failure, and supplementary services, such as call forwarding. Monitoring all of these services further enhances the accuracy and granularity of presence information. For example, if an SMS message is determined to be undeliverable, the presence status for a subscriber may be set to unreachable for receiving text messages.

As illustrated in Figure 1, in one exemplary implementation, presence information is derived from signaling messages at an STP. Deriving presence information from signaling messages that traverse an STP is advantageous because the solution will work with existing handsets without requiring modifications of the handset or other devices to include presence clients. In addition, the presence information collected at an STP is more accurate than information collected using a single network element, such an HLR or a GPRS node. In addition, since STPs now include IP communications capabilities, presence information can be obtained with requiring direct access to HLR devices using SS7 protocols.

One disadvantage to deriving presence information based on signaling messages that traverse an STP is that the STP may not have visibility for intra-MSC, non-roaming calls. Similarly, in wireline networks, the STP does not have visibility for calls that involve a single switch or calls between switches that have direct signaling connections. In these cases, probes may be placed at the

switches to detect the signaling messages associated with these calls. In another example, an STP may not have visibility for PDP context related protocol exchange between an SGSN and GGSN. Accordingly, as illustrated in Figure 1, probes **120** are connected to both SGSN **104** and GGSN **106** to avoid this difficulty.

According to another aspect of the subject matter described herein, presence information may be maintained for multiple identities of a subscriber. For mobile network subscribers, the identities may include IMSIs, MSISDN numbers, and subscriber email addresses. For landline subscribers, the presence information may include subscriber directory numbers and routing numbers for ported subscribers.

Analysis of signaling messages of one or more protocols may be used to derive high level presence information, such as voice communications availability, in addition to network presence. For example, ISUP or SIP call setup and/or call tear down signaling messages may be used to determine whether a potential presentity is available to receive voice communications in addition to network presence.

The examples described above relate to monitoring many types of messages to derive presence information. The following list illustrates some of those messages and additional messages that may be monitored by presence gateway **122** to derive presence information. All of the following messages have a corresponding RESULT message in the opposite direction. Monitoring of the RESULT message may also be performed though not explicitly referenced below.

MAP/D UPDATE LOCATION - from VLR to HLR

Note: Initiated when subscriber turns on phone or changes location for GSM Services. The result will indicate if the Registration is accepted or rejected.

MAP/D CANCEL LOCATION - HLR to old VLR

Note: Indicates that subscriber has moved to a new GSM location and old VLR must remove the subscriber from its records.

MAP/D INSERT SUBSCRIBER DATA - from HLR to VLR

Note: Subscriber related data is downloaded to VLR to synchronize VLR and HLR view of the subscriber status.

MAP/D DEREGISTER MOBILE SUBSCRIBER - VLR to HLR

Note: Sparingly used.

MAP/D SEND PARAMETERS - VLR to HLR

Note: Requesting IMSI and authenticating triplets.

MAP/G SEND Parameters - from new MSC to previous MSC

Note: To request IMSI and authenticate triplets.

MAP/D PROVIDE ROAMING NUMBER - from HLR to VLR

Note: An incoming call to the GMSC (from outside the network) triggers the event.

MAP/C SEND ROUTING INFORMATION - from GMSC to HLR

Note: An incoming call to the GMSC (from outside the network) triggers this event.

MAP/C Send Routing Info for SM - from SMS gateway to HLR

Note: An incoming short message triggers this message.

MAP/C SET MESSAGE - Waiting data result, from SMS gateway to HLR

Note: Indicates that the SMS message was not delivered because it was unreachable.

MAP/D Note MS PRESENT - from MSC to HLR

Note: After not able to deliver a SM, if the MSC/VLR identifies the presence of the mobile subscriber, this message is sent.

MAP/C ALERT SERVICE CENTER - from HLR top SMS Gateway:

Note: This is an alert from HLR to SMS gateway to resend the message indicating that an earlier unavailable subscriber has now become available.

MAP/H - FORWARD SHORT MESSAGE - from MSC to SMS-C

Note: This indicates a MO SM and is used to identify the mobile as present.

ISUP Messages:

Indicate the presence status of originating and terminating subscriber.

IAM

ACM

ANW

REL/RLC

Note: ISUP messages can be used to obtain the presence status of both originating and terminating subscriber. They can also be used to obtain higher level presence information, such as information indicating that subscriber is in a call. However there are cases where STP may not see an ISUP messages, such as intra-MSC, non-roaming call. In such cases, probes located at the switch or MSC may be used to collect messages used to derive presence information.

MAP/D UPDATE LOCATION - from SGSN to HLR

Note: Initiated when subscriber turns on phone or changes location for GPRS services. The result will indicate if the registration is accepted or rejected.

MA/D INSERT SUBSCRIBER DATA - from HLR to SGSN

Note: Subscriber related data is downloaded to SGSN to synchronize SGSN & HLR view of the subscriber status.

SEND AUTHENTICATION INFO - from SGSN to AuC

Note: To get authentication triplet for an IMSI

SGSN CONTEXT REQUEST/RESPONSE/ACK - from new SGSN to old SGSN

Note: This event results because of a Routing Area Update of the GPRS handset from old SGSN to a new SGSN.

MAP/D CANCEL LOCATION - HLR to old SGSN

Note: Sent for HLR to old SGSN as a result of GPRS subscriber updating Routing Area.

LNP Query and Responses:

These indicate the availability of the subscriber.

Call Forwarding Implications:

Subscriber has activated call forwarding (unconditional or unreachable).

It will be understood that various details of the invention may be changed without departing from the scope of the invention. Furthermore, the foregoing description is for the purpose of illustration only, and not for the purpose of limitation, as the invention is defined by the claims as set forth hereinafter.

CLAIMS

What is claimed is:

1. A method for maintaining and delivering presence information regarding telecommunications network subscribers, the method comprising:

(a) deriving presence information for a first set of telecommunications network subscribers based on telecommunications signaling messages relating to communications to or from members of the first set of subscribers, the first set of subscribers including at least one subscriber who is not currently subscribed to in a presence database;

(b) determining whether presence status associated with a first subscriber in the first set of subscribers has changed based on the presence information derived for the first subscriber;

(c) in response to determining that the presence status associated with the first subscriber has changed, determining whether the first subscriber is a subscribed-to presentity; and

(d) in response to determining that the first subscriber is a subscribed-to presentity, notifying a presence server of the change in presence status of the first subscriber.

2. The method of claim 1 wherein deriving presence information comprises:

(a) receiving telecommunications signaling messages associated with a plurality of subscribers;

(b) identifying predetermined signaling messages from which presence information may be derived;

(c) from the predetermined signaling messages, identifying messages that contain identifying information associated with subscribers in the first set of subscribers; and

(d) based on the signaling messages containing identifying information associated with subscribers in the first set of subscribers, generating presence status events for the subscribers in the first set of subscribers.

3. The method of claim 2 wherein identifying predetermined signaling messages from which presence information may be derived includes identifying predetermined PSTN call signaling messages.

4. The method of claim 2 wherein identifying predetermined signaling messages from which presence information may be derived includes identifying predetermined mobile signaling messages.

5. The method of claim 2 wherein identifying predetermined signaling messages includes identifying predetermined IP telephony signaling messages.

6. The method of claim 2 wherein identifying predetermined signaling messages includes identifying GSM and GPRS signaling messages and wherein generating presence status events includes generating the presence status events based on the GSM and GPRS signaling messages.

7. The method of claim 2 wherein identifying signaling messages includes collecting signaling messages that do not traverse a signal transfer point (STP) and wherein generating presence status events includes generating the presence status events for the signaling messages that do not traverse the STP.

8. The method of claim 2 wherein identifying signaling messages includes collecting signaling messages destined for a plurality of different network elements and wherein generating presence status events includes generating presence status events based on the collected call signaling messages.

9. The method of claim 2 wherein generating presence status events includes generating a registration event for a mobile subscriber in response to receiving a mobile call signaling message indicating registration of the mobile subscriber.

10. The method of claim 2 wherein generating presence status events includes generating a roaming event in response to receiving a mobile signaling message indicating that a mobile subscriber is roaming.

11. The method of claim 2 wherein generating presence status events includes generating a handset off event in response to receiving a

signaling message indicating that a mobile subscriber has deactivated a mobile handset.

12. The method of claim 1 wherein deriving presence information for a first set of telecommunications network subscribers includes maintaining a first database of potential presentities and continuously deriving and storing presence information for the potential presentities.

13. The method of claim 12 wherein determining whether the first subscriber is a subscribed-to presentity includes maintaining a second database of subscribed-to presentities representing a second set of subscribers different from the first set of subscribers and determining whether the first subscriber is present in the second database.

14. The method of claim 12 wherein maintaining a first database of potential presentities includes maintaining a plurality of identities for at least one of the potential presentities.

15. A method for deriving high-level presence information based on received signaling messages, the method comprising:

(a) receiving a plurality of signaling messages;

(b) screening, from the signaling messages, at least one of call setup and call tear down messages regarding a subscribed-to presentity;

(c) deriving, from the at least one of call setup and call tear down messages regarding the subscribed-to presentity, network location and voice communication availability information; and

(d) forwarding the network location and voice communication availability information to a presence server.

16. A method for storing presence information on behalf of a presence server, the method comprising:

(a) deriving presence information for a subscriber based on signaling messages relating to the subscriber;

(b) storing the presence information for the subscriber in a database separate from a presence server;

(c) determining whether a change in presence status has occurred for the subscriber; and

(d) in response to determining that a change in presence status has occurred, communicating the presence information for the subscriber to the presence server.

17. A method for communicating presence information to a presence server, the method comprising:

(a) deriving presence information for a subscriber based on signaling messages concerning the subscriber;

(b) receiving a subscription request from a presence server for obtaining presence information regarding the subscriber; and

(c) in response to the subscription request, communicating the presence information to the presence server.

18. The method of claim 17 comprising continuously deriving presence information for the subscriber and automatically updating the presence server in response to detecting changes in the presence information.

19. A presence server gateway comprising:

(a) a presence gateway correlator for receiving telecommunications signaling messages, for determining whether the telecommunications signaling messages are associated with subscribers in a first group of subscribers, the first group of subscribers including at least one subscriber who is not currently subscribed to in a presence database and for generating presence status events based on the signaling messages associated with the subscribers in first group of subscribers; and

(b) an event manager operatively associated with the presence gateway correlator for receiving the presence status events from the message correlator, for determining whether the presence status events are associated with subscribed-to presentities, and, in response to determining that the events are associated with subscribed-to presentities, for communicating the presence status events to a presence server.

20. The gateway of claim 19 wherein the presence gateway correlator is adapted to continuously derive presence information for subscribers in the first group of subscribers based on PSTN call signaling messages received for subscribers in the first group of subscribers.

21. The gateway of claim 19 wherein the presence gateway correlator is adapted to continuously derive presence information for subscribers in the first group of subscribers based on mobile signaling messages relating to subscribers in the first group of subscribers.

22. The gateway of claim 19 wherein the presence gateway correlator is adapted to generate registration events in response to detecting registration of a subscriber in the first group of subscribers.

23. The gateway of claim 19 wherein the event manager is adapted to generate a roaming event in response to detecting roaming of a subscriber in the first group of subscribers.

24. The gateway of claim 19 wherein the message correlator is adapted to generate handset off event in response to detecting deactivation of a handset of a subscriber in the first group of subscribers.

25. The gateway of claim 19 wherein the presence gateway correlator is adapted to receive GSM and GPRS messages regarding subscribers in the first group and to generate a presence status event based on the GSM and GPRS messages.

26. The gateway of claim 19 wherein the presence gateway correlator is adapted to receive signaling messages that do not traverse a signal transfer point (STP) and to generate the events based on the signaling messages that do not traverse the STP.

27. The gateway of claim 19 wherein the presence gateway correlator is adapted to receive signaling messages destined for a plurality of different network nodes and to generate the presence information based on the signaling messages received from the different network nodes.

28. The gateway of claim 19 comprising a potential presentities database accessible by the message correlator for identifying members of the first group of subscribers.

29. The gateway of claim 28 wherein the potential presentities database includes at least one entry storing multiple identities for a subscriber.

30. The gateway of claim 19 comprising a subscribed-to presentities database accessible by the event manager for storing information usable by the event manager for indicating whether a presence status event is associated with a subscribed-to presentity.

31. A system for communicating presence information to a presence server, the system comprising:

(a) a plurality of probes for collecting signaling message regarding a subscriber;

(b) a presence gateway for receiving the signaling message, for deriving presence information for the subscriber based on the signaling messages concerning the subscriber, for receiving a subscription request from a presence server for obtaining presence information regarding the subscriber, and, in response to the subscription request, for communicating the presence information to the presence server.

32. The system of claim 31 wherein the presence gateway is adapted to continuously derive presence information for the subscriber and to automatically update the presence server in response to detecting changes in the presence information.

33. A computer program product comprising computer executable instructions embodied in a computer readable medium for performing steps comprising:

(a) analyzing a plurality of telecommunications signaling messages;

(b) from the signaling messages, identifying messages concerning subscribed-to presentities and non-subscribed-to presentities;

(c) deriving presence status information regarding the subscribed-to presentities based on the signaling messages identified as concerning the subscribed-to presentities and communicating the presence status information to a presence server; and

(d) deriving presence status information for the non-subscribed-to presentities based on the signaling messages identified as concerning the non-subscribed-to presentities and storing the presence status information in a database separate from the presence server.

34. The computer program product of claim 33 comprising receiving a subscribe message from a presence server for subscribing to one of the non-subscribed-to presentities, and, in response:

(a) extracting presence status information from the database for the presentity identified in the subscribe message; and

(b) communicating the presence status information to the presence server.

5

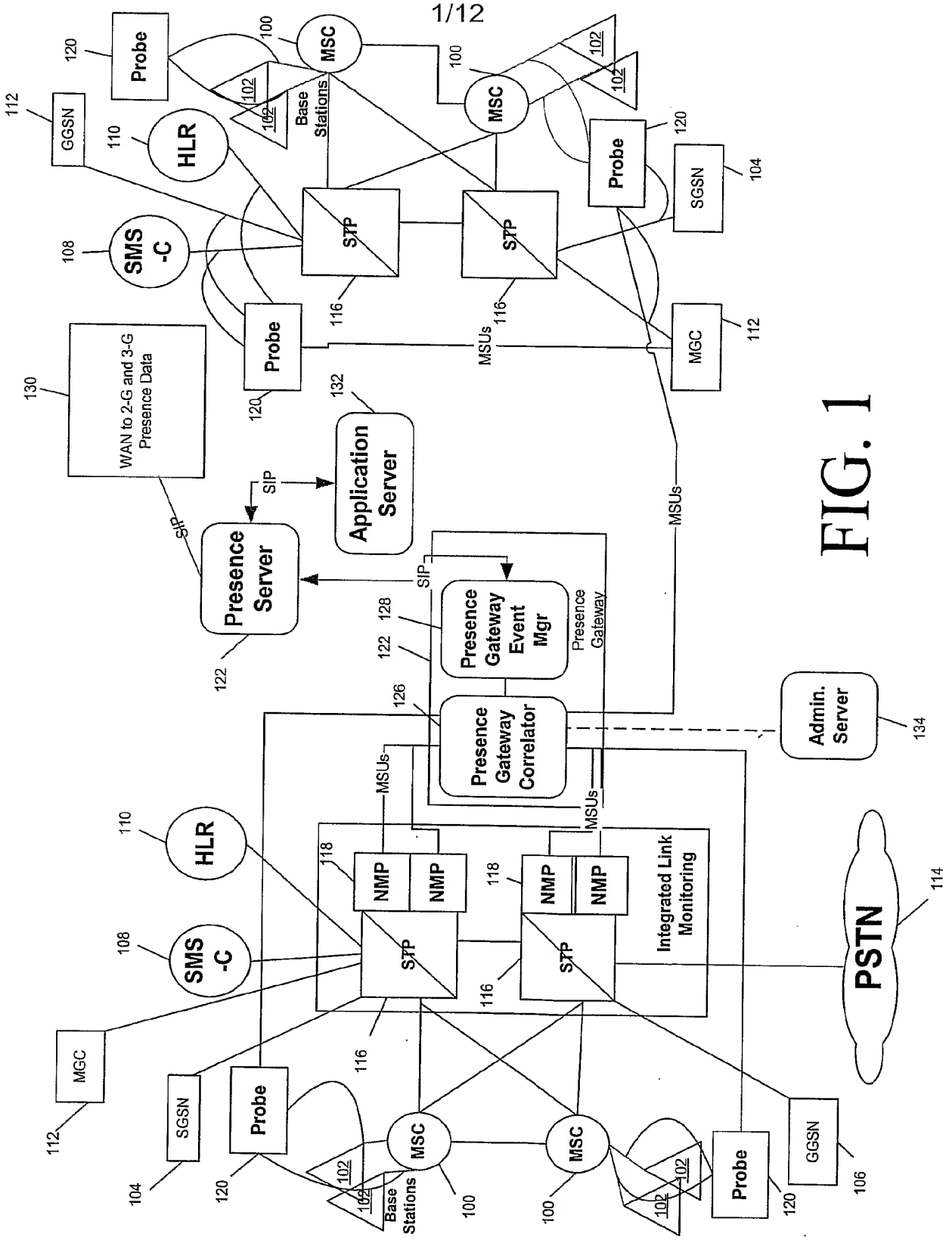

Probe
MSC
GGSN
HLR
Base Stations
SMS -C
STP
SGSN
WAN to 2-G and 3-G Presence Data
MSUs
MGC
Application Server
SIP
Presence Server
Presence Gateway Event Mgr
Presence Gateway
Presence Gateway Correlator
Admin. Server
NMP
Integrated Link Monitoring
PSTN

FIG. 1

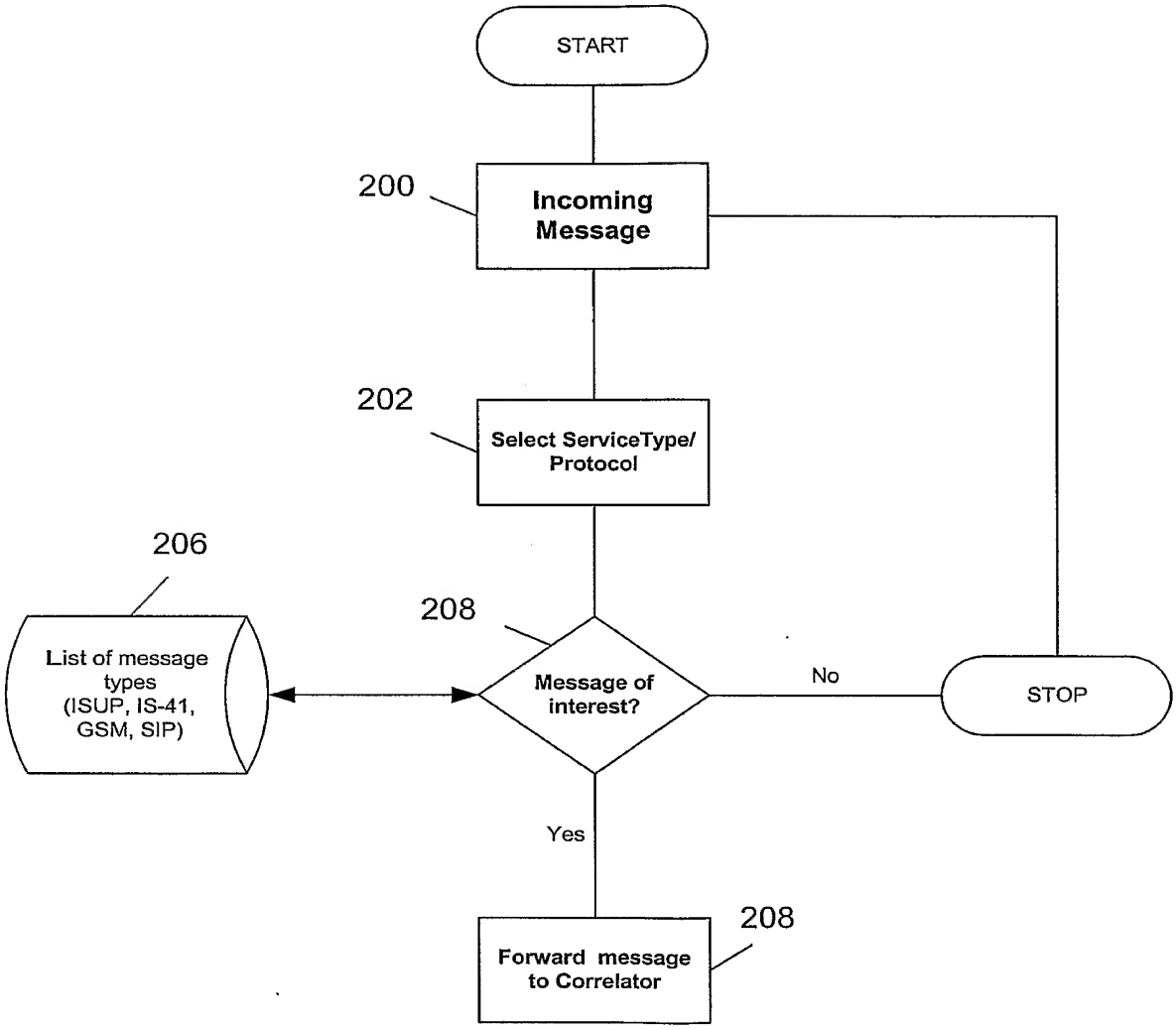

START
200
Incoming Message
202
Select ServiceType/ Protocol
206
List of message types (ISUP, IS-41, GSM, SIP)
208
Message of interest?
No
STOP
Yes
208
Forward message to Correlator

FIG. 2

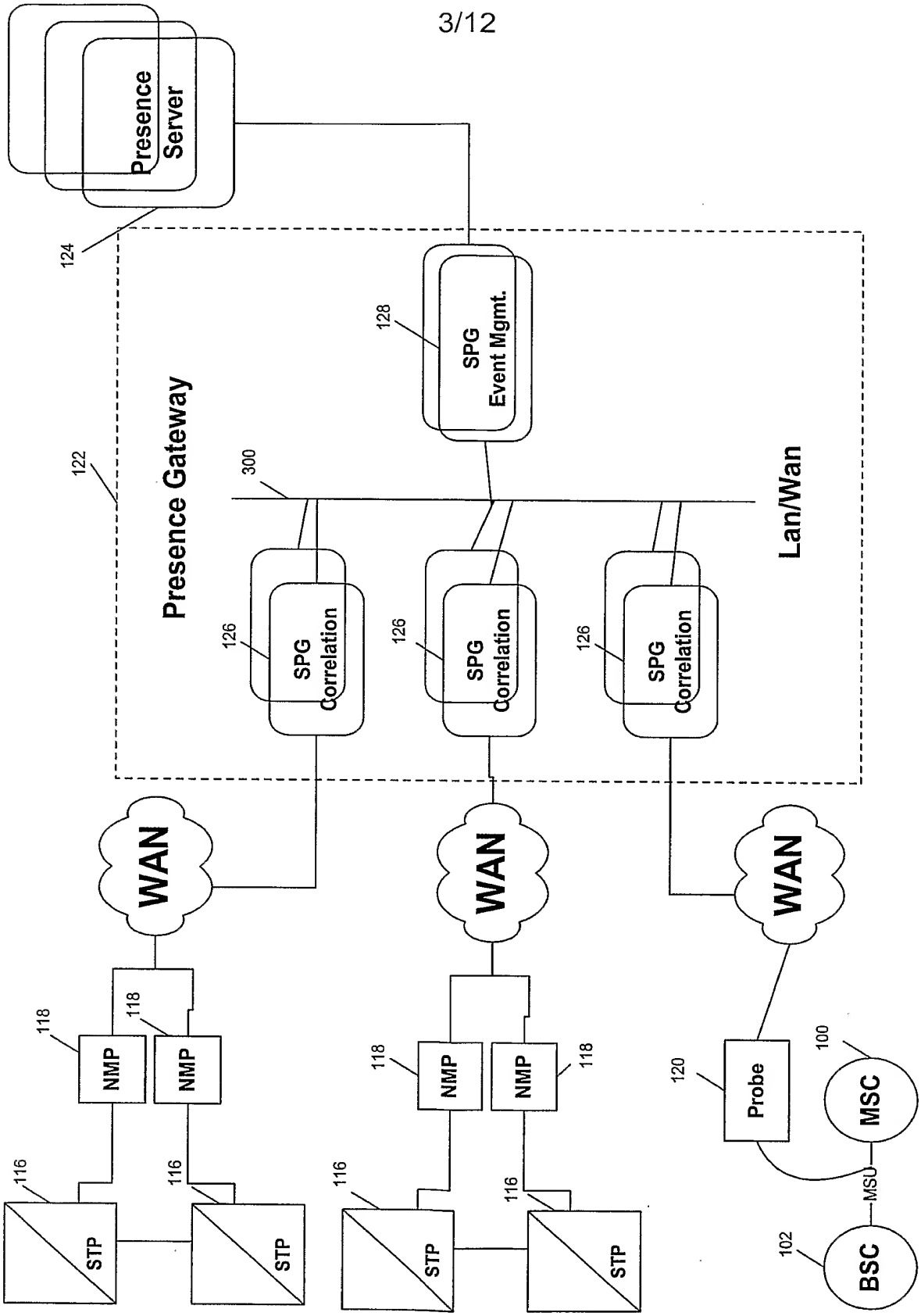

Presence Server
124
Presence Gateway
122
SPG Event Mgmt.
128
300
Lan/Wan
SPG Correlation
126
WAN
NMP
118
STP
116
Probe
120
MSC
100
MSU
BSC
102

FIG. 3

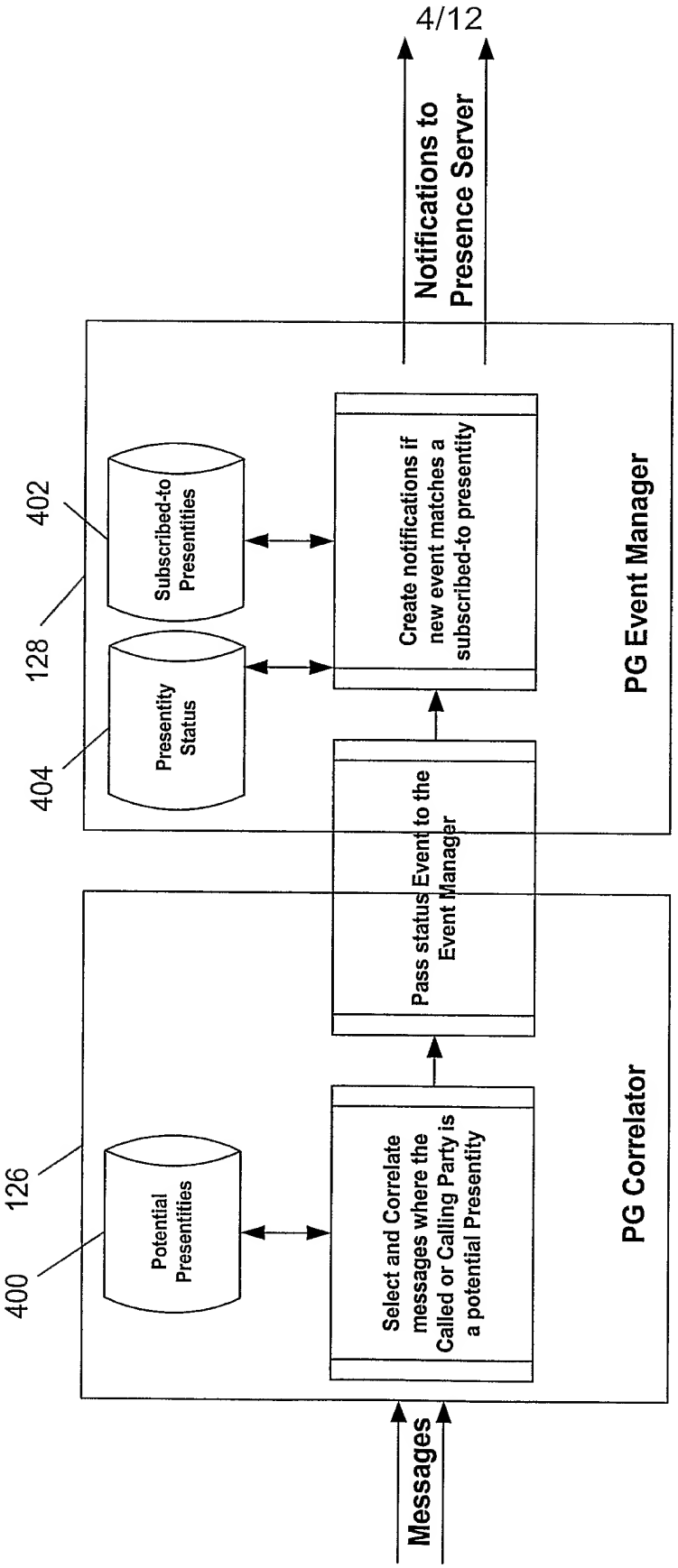

Messages
PG Correlator
400
126
Potential Presentities
Select and Correlate messages where the Called or Calling Party is a potential Presentity
Pass status Event to the Event Manager
PG Event Manager
404
128
402
Presentity Status
Subscribed-to Presentities
Create notifications if new event matches a subscribed-to presentity
Notifications to Presence Server

FIG. 4

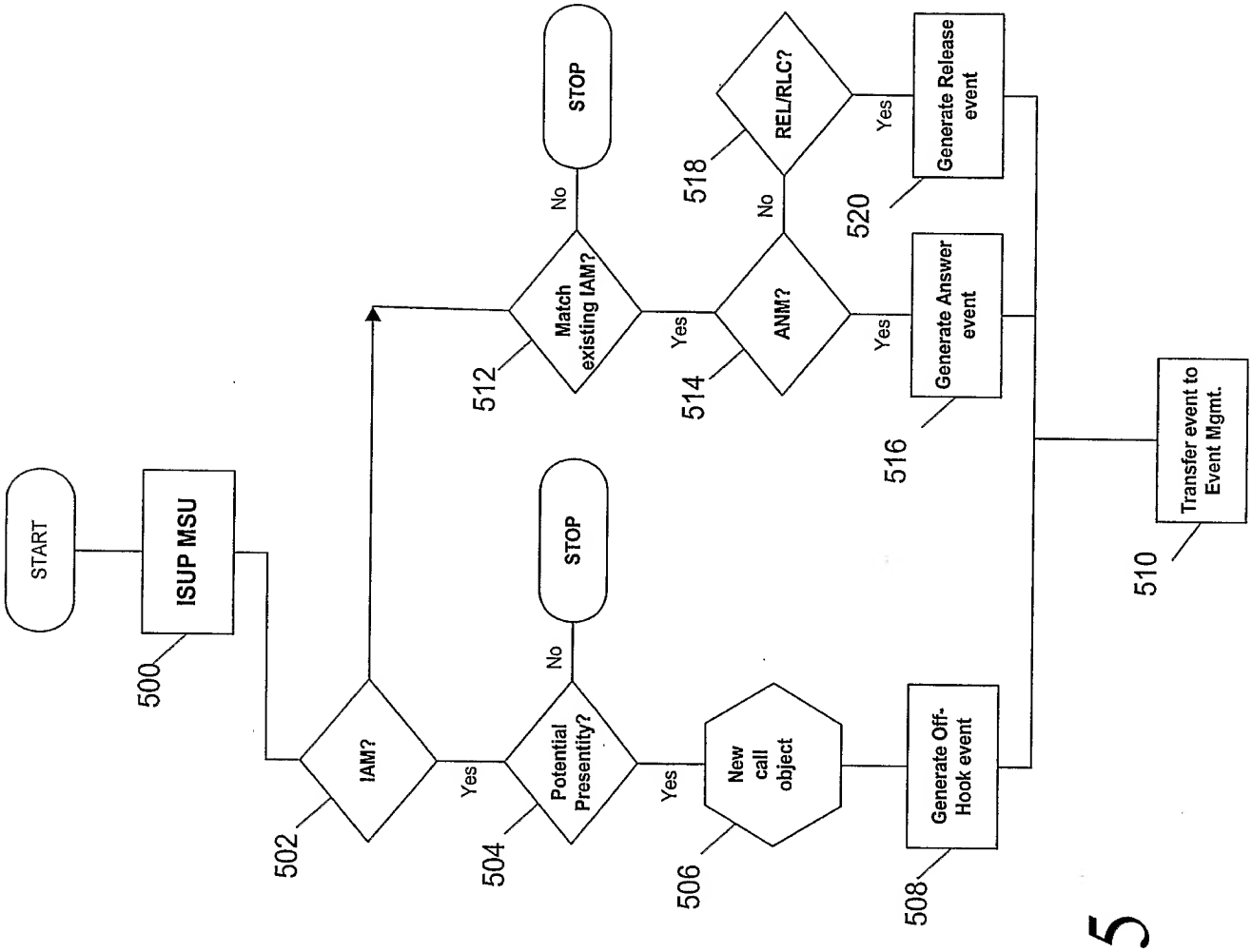
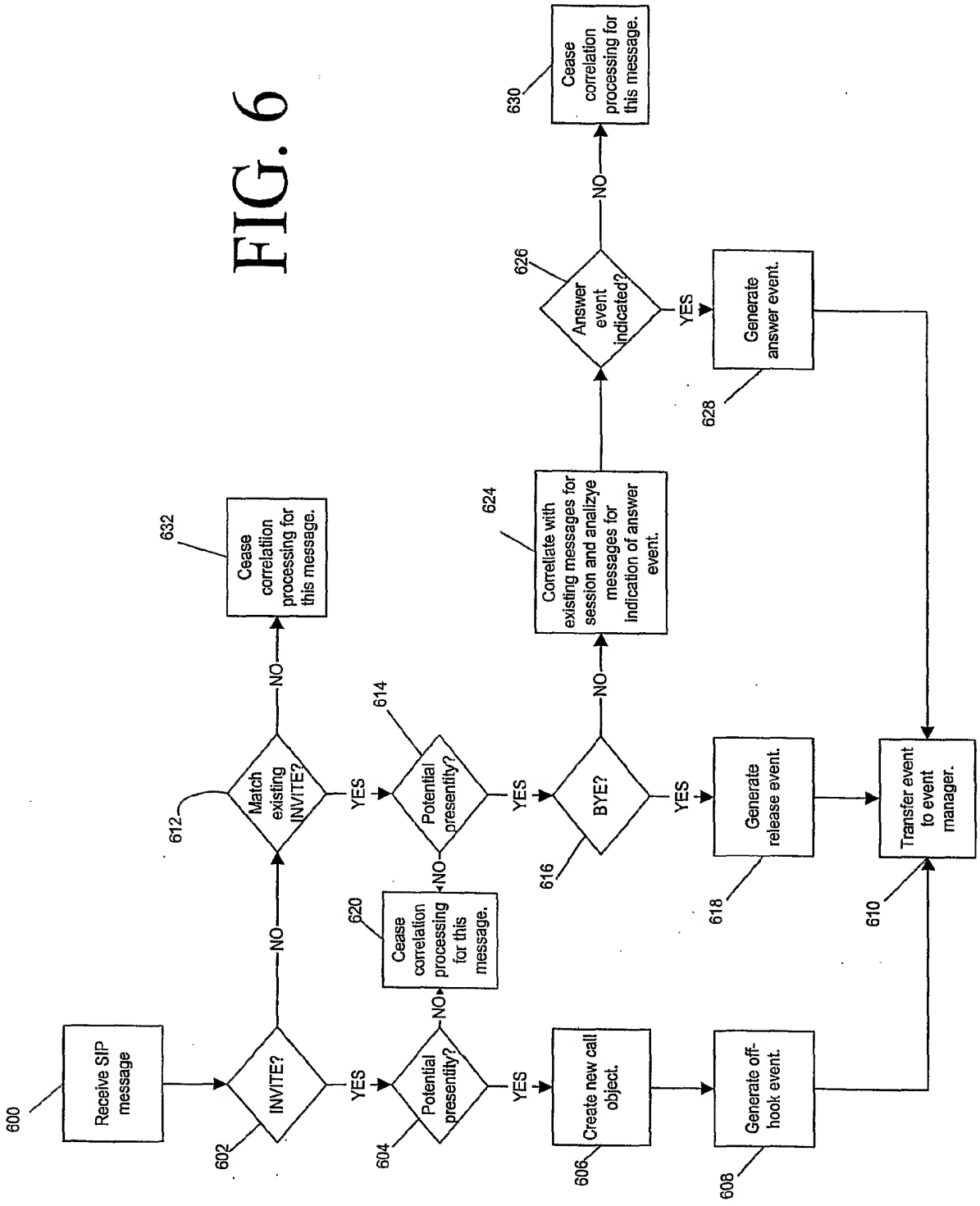

START
ISUP MSU
500
IAM?
502
Yes
No
STOP
Potential Presentity?
504
Yes
New call object
506
Generate Off-Hook event
508
Transfer event to Event Mgmt.
510
Match existing IAM?
512
Yes
No
STOP
ANM?
514
Yes
Generate Answer event
516
No
REL/RLC?
518
Yes
Generate Release event
520

FIG. 5

FIG. 6


600
Receive SIP message
602
INVITE?
YES
NO
604
Potential presentity?
YES
NO
606
Create new call object.
608
Generate off-hook event.
610
Transfer event to event manager.
612
Match existing INVITE?
YES
NO
614
Potential presentity?
YES
NO
616
BYE?
YES
NO
618
Generate release event.
620
Cease correlation processing for this message.
624
Correlate with existing messages for session and analizye messages for indication of answer event.
626
Answer event indicated?
YES
NO
628
Generate answer event.
630
Cease correlation processing for this message.
632
Cease correlation processing for this message.

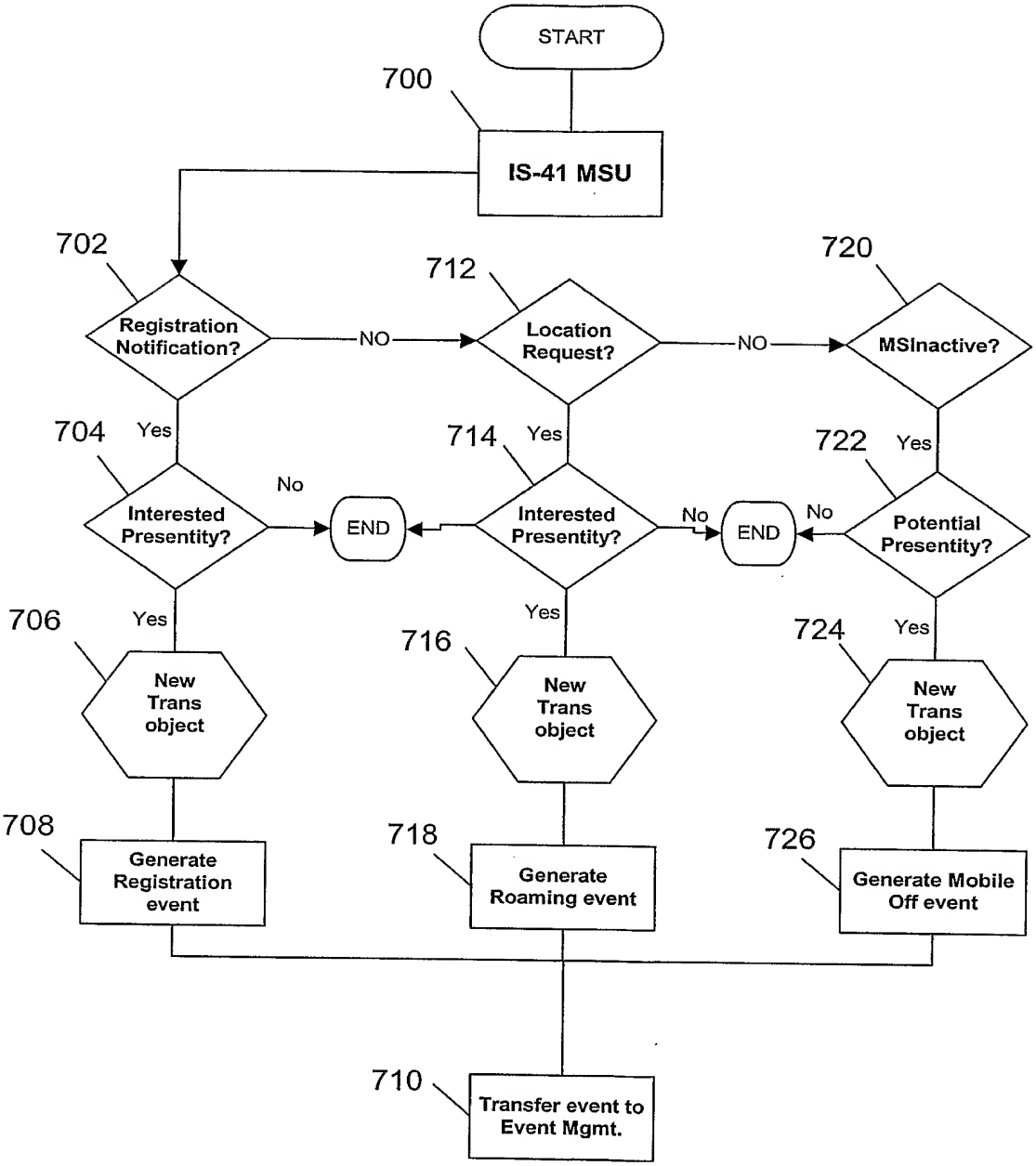

START
700
IS-41 MSU
702
Registration Notification?
NO
712
Location Request?
NO
720
MSInactive?
704
Yes
714
Yes
722
Yes
Interested Presentity?
No
END
Interested Presentity?
No
END
No
Potential Presentity?
706
Yes
716
Yes
724
Yes
New Trans object
New Trans object
New Trans object
708
Generate Registration event
718
Generate Roaming event
726
Generate Mobile Off event
710
Transfer event to Event Mgmt.

FIG. 7

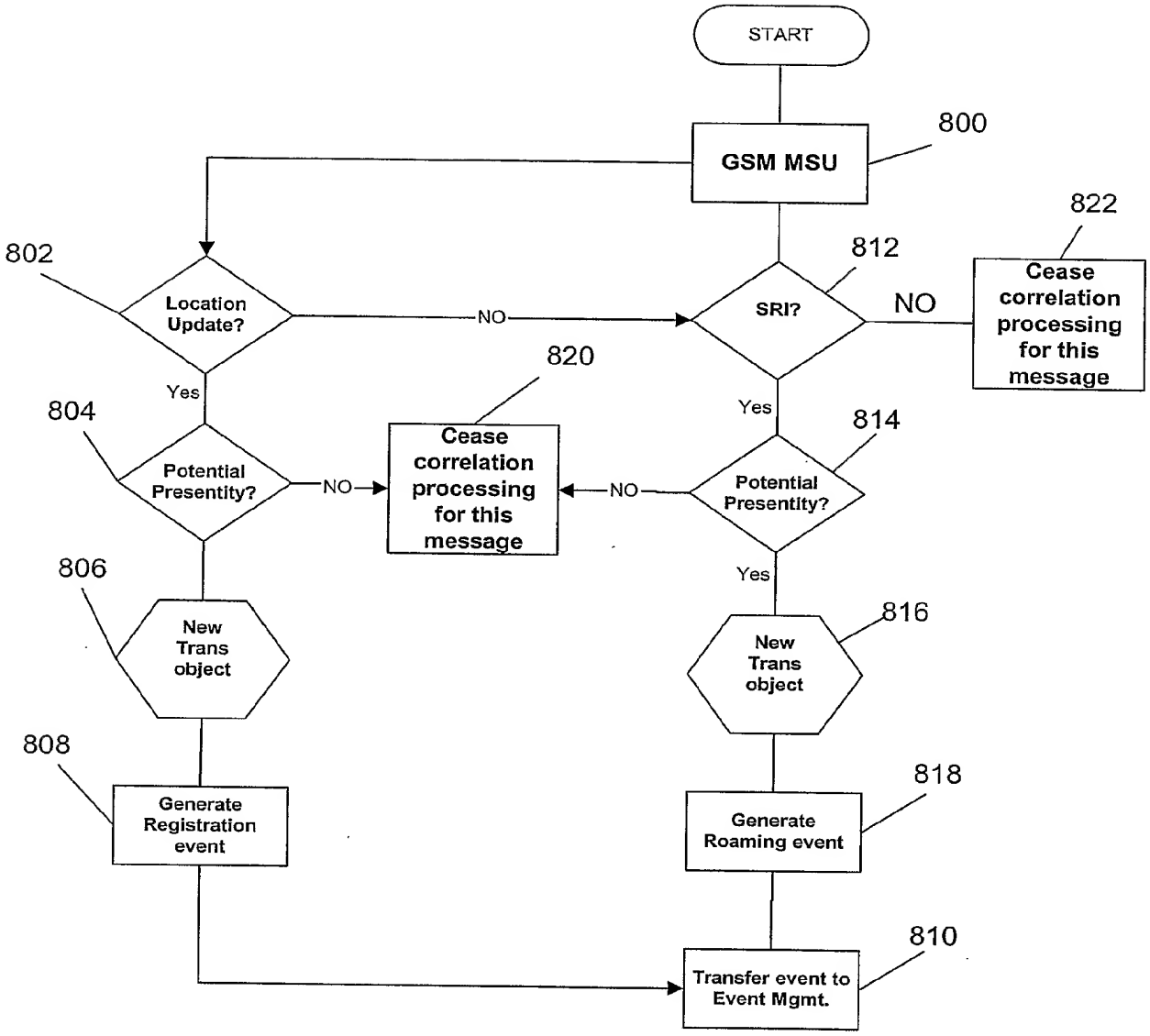

START
GSM MSU
800
822
802
812
Location Update?
NO
SRI?
NO
Cease correlation processing for this message
820
Yes
Yes
804
814
Potential Presentity?
NO
Cease correlation processing for this message
NO
Potential Presentity?
Yes
806
816
New Trans object
New Trans object
808
818
Generate Registration event
Generate Roaming event
810
Transfer event to Event Mgmt.

FIG. 8

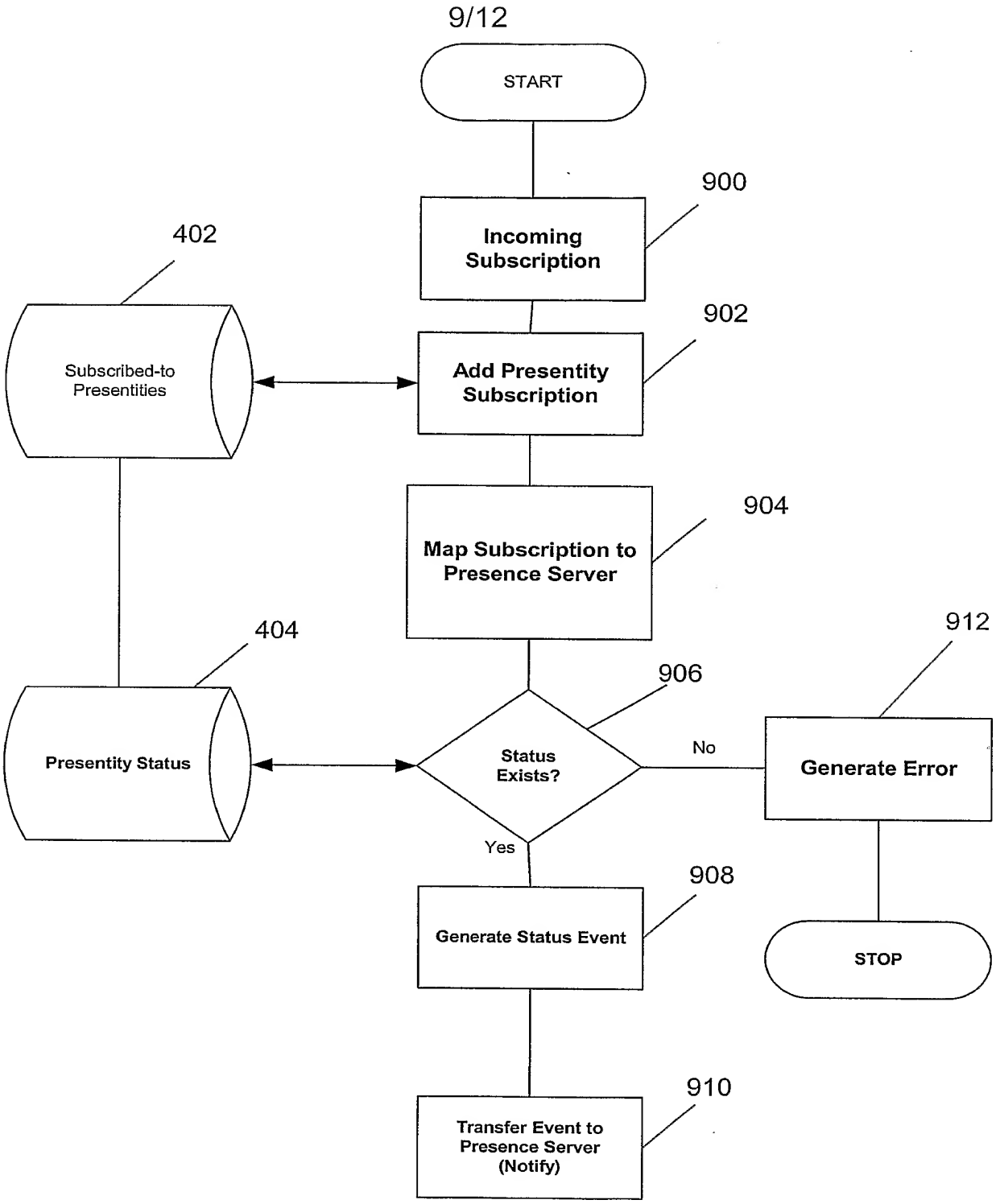

START
900
Incoming Subscription
402
Subscribed-to Presentities
902
Add Presentity Subscription
904
Map Subscription to Presence Server
404
Presentity Status
906
Status Exists?
No
912
Generate Error
Yes
908
Generate Status Event
STOP
910
Transfer Event to Presence Server (Notify)

FIG. 9

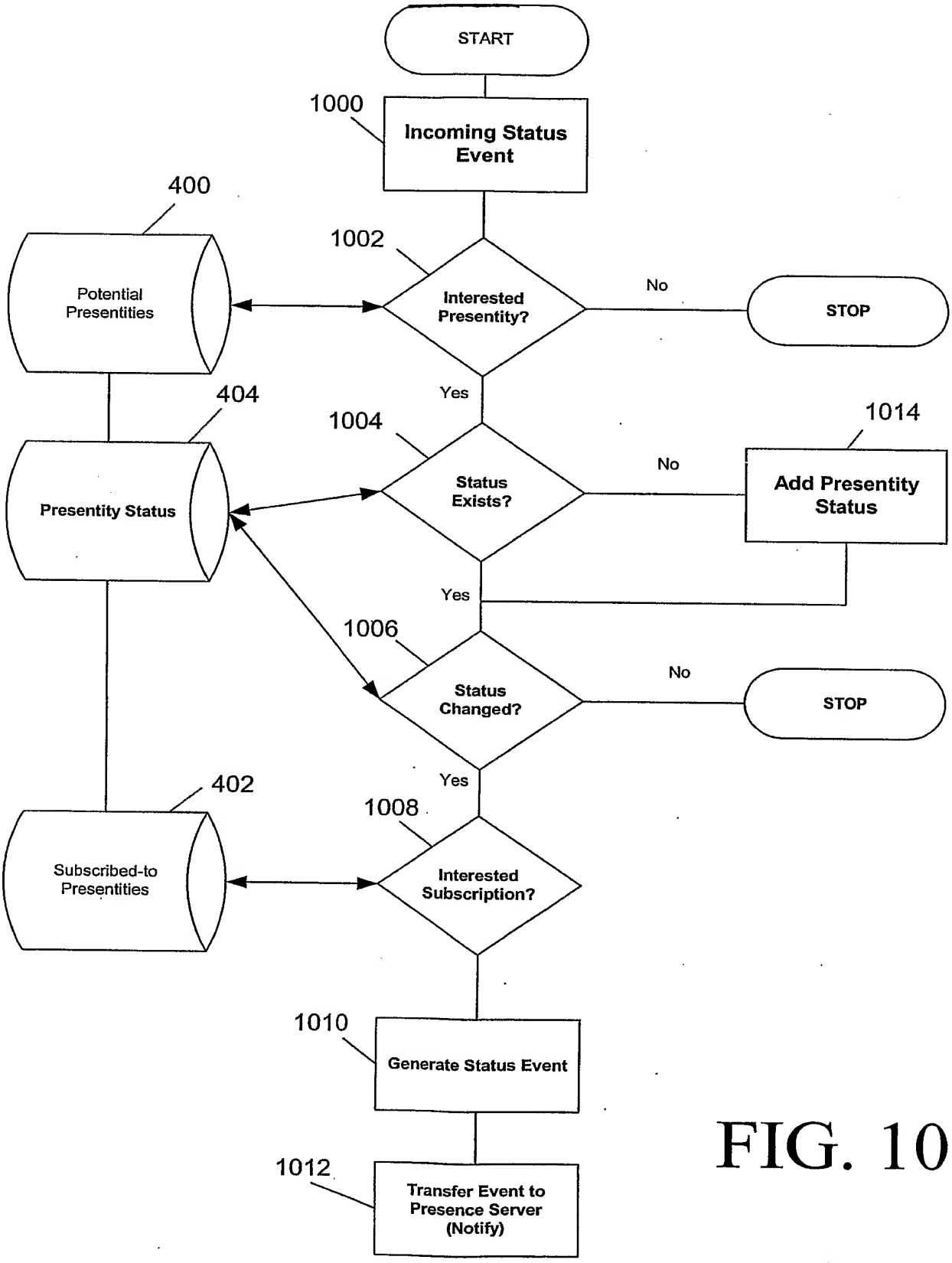

START
1000
Incoming Status Event
400
Potential Presentities
1002
Interested Presentity?
No
STOP
Yes
404
1004
Presentity Status
Status Exists?
No
1014
Add Presentity Status
Yes
1006
Status Changed?
No
STOP
Yes
402
1008
Subscribed-to Presentities
Interested Subscription?
1010
Generate Status Event
1012
Transfer Event to Presence Server (Notify)

FIG. 10

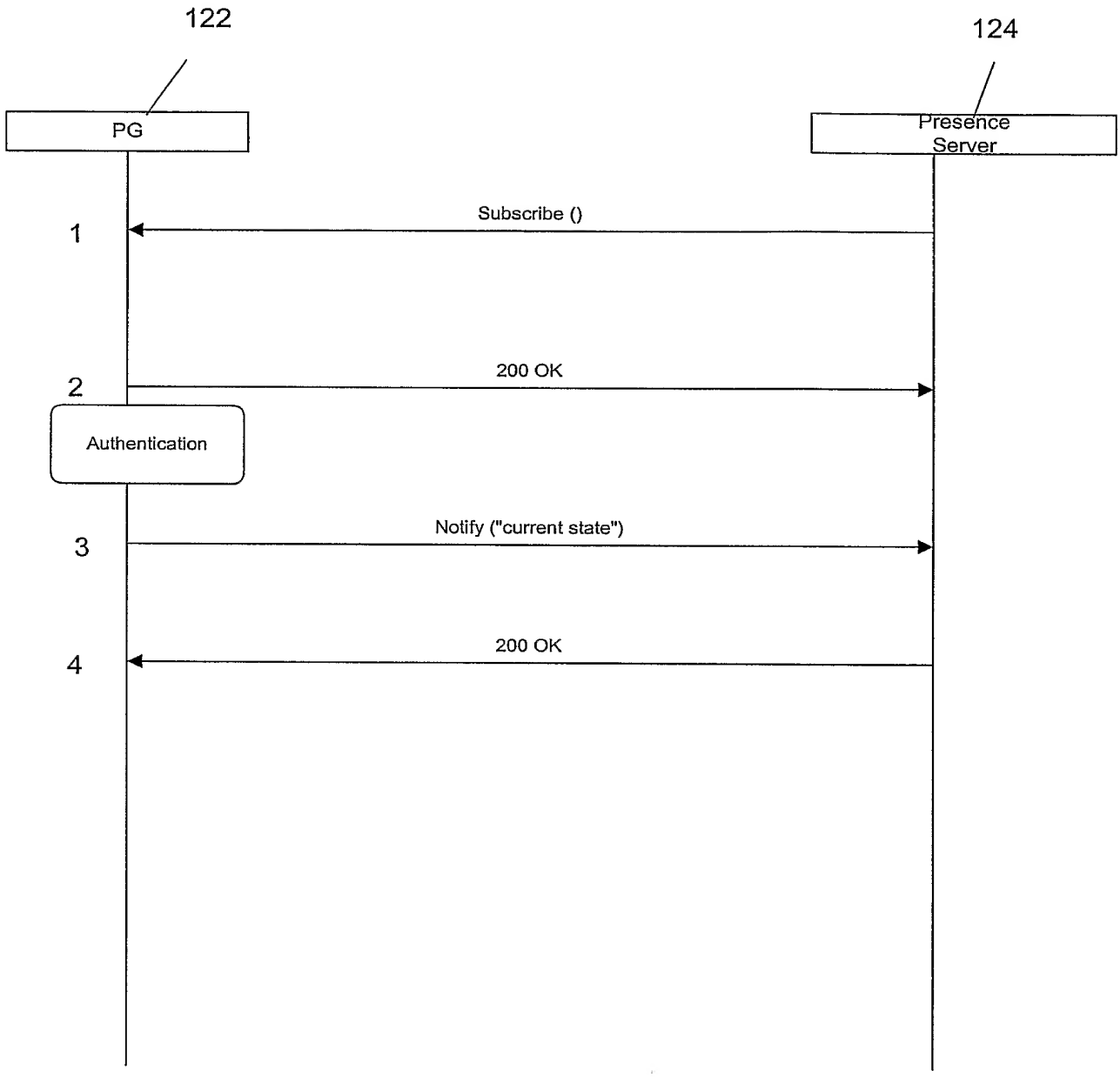

122
124
PG
Presence Server
1
Subscribe ()
2
200 OK
Authentication
3
Notify ("current state")
4
200 OK

FIG. 11

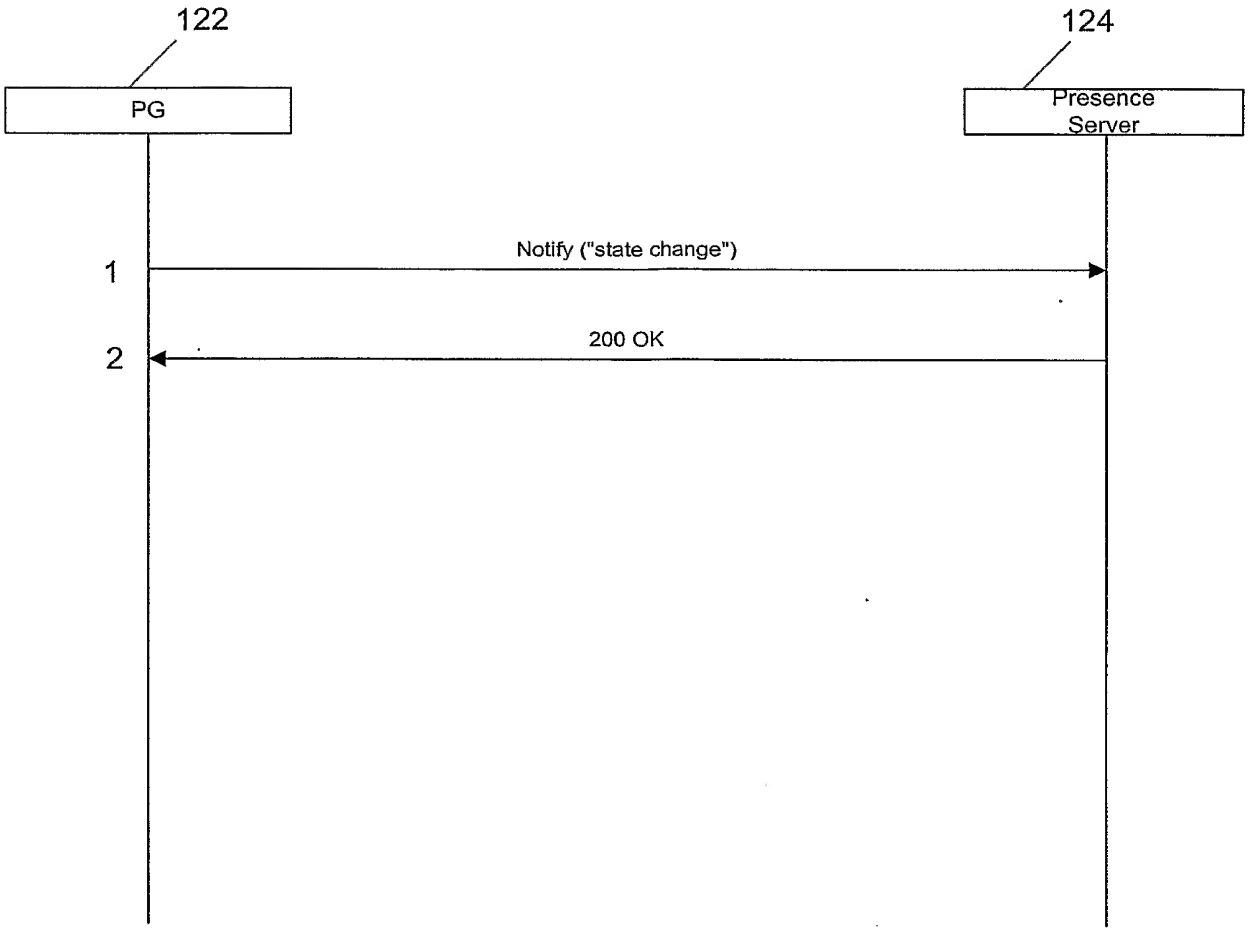



FIG. 12